

18. Partial assessment of the skate stock complex in the Bering Sea and Aleutian Islands

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Executive Summary

The Bering Sea and Aleutian Islands (BSAI) skate complex is managed in aggregate, with a single set of harvest specifications applied to the entire complex. However, to generate the harvest recommendations the stock is divided into two units. Harvest recommendations for Alaska skate *Bathyraja parmifera*, the most abundant skate species in the BSAI, are made using the results of an age structured model and are managed under Tier 3. The remaining species (“other skates”) are managed under Tier 5 due to a lack of data. The Tier 3 and Tier 5 recommendations are combined to generate recommendations for the complex as a whole.

Beginning in 2017, groundfish stocks managed by the North Pacific Fishery Management Council are on a new assessment cycle. As was previously the case, full assessments for the BSAI skate complex will be conducted in even years when full survey data are available. In off years, the previous update format has been expanded to include more complete data regarding catch and biomass.

Summary of Changes in Assessment Inputs

Changes in the input data:

- 1) Catch data have been updated through October 17, 2021. The 2020 catch data used in the projection model have been updated, and new estimates of 2021 and 2022 catches were created for use in the projection model.
- 2) Survey biomass estimates from the 2021 eastern Bering Sea (EBS) shelf bottom trawl survey have been included.

Changes in assessment methodology:

- 1) There were no changes to the assessment methodology. The projection model for harvest recommendations was re-run with updated catch data.

Summary of results

- 1) The trend of lower catches of skates in the BSAI since 2018 continues through 2021 (Table 1).
- 2) The survey biomass estimate for the aggregate skate complex on the EBS shelf decreased slightly relative to 2019 (511,965 t in 2021 vs. 528, 826 t in 2019; Figure 1).
- 3) The estimated EBS shelf biomass for Alaska skate (the most abundant species on the shelf) decreased slightly from 2019 (Tables 2 and 3; Figure 1). The northern Bering Sea (NBS) survey continues to encounter Alaska skate (Table 3 and Figure 2), with the biomass estimate for Alaska skate in the NBS decreasing slightly in 2021.

- 4) The estimated EBS shelf biomass for the Other Skate assemblage (all skates except for Alaska skate) increased slightly in 2021 relative to 2019 (Table 2; Figure 1). This was largely due to increased biomass estimates for Aleutian, Bering, and big skates.
- 5) Exploitation rates for Alaska skate and Other Skates decreased in 2019, the last year when full data were available for the calculation (since no survey occurred in 2020, Figure 3).
- 6) The harvest recommendations for 2022 have changed slightly from last year's assessment, and recommendations for 2023 are included.

Alaska skate harvest recommendations				
Quantity	As estimated or specified <i>last</i> year for:		As estimated or recommended <i>this</i> year for:	
	2021	2022	2022*	2023*
M (natural mortality rate)	0.13	0.13	0.13	0.13
Tier	3a	3a	3a	3a
Projected total (age 0+)	504,691	484,731	489,868	476,753
Female spawning biomass (t)				
Projected	123,390	119,498	121,575	115,692
$B_{100\%}$	178,425	178,425	178,425	178,425
$B_{40\%}$	71,370	71,370	71,370	71,370
$B_{35\%}$	62,449	62,449	62,449	62,449
F_{OFL}	.092	.092	.092	.092
$\max F_{ABC}$.079	.079	.079	.079
F_{ABC}	.079	.079	.079	.079
OFL (t)	38,580	36,655	37,073	35,758
$\max ABC$ (t)	33,219	31,560	31,920	30,786
ABC (t)	33,219	31,560	31,920	30,786
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a
Overfished	n/a	No	n/a	No
Approaching overfished	n/a	No	n/a	No

* The catch data used in the projection model that produces these recommendations are presented in Table 1. The full 2021 catch was estimated by multiplying the partial 2021 catch by a correction factor based on the additional catch that occurred after October in the 5 previous years.

other skate harvest recommendations				
Quantity	As estimated or specified last year for:		As estimated or recommended this year for:	
	2021	2022	2022	2023
<i>M</i> (natural mortality rate)	0.1	0.1	0.1	0.1
Tier	5	5	5	5
Biomass (t)	107,174	107,174	107,174	107,174
F _{OFL}	0.10	0.10	0.10	0.10
maxF _{ABC}	0.075	0.075	0.075	0.075
F _{ABC}	0.075	0.075	0.075	0.075
OFL (t)	10,717	10,717	10,717	10,717
maxABC (t)	8,038	8,038	8,038	8,038
ABC (t)	8,038	8,038	8,038	8,038
Status	As determined <i>last</i> year for:		As determined <i>this</i> year for:	
	2019	2020	2020	2021
Overfishing	No	n/a	No	n/a

aggregate harvest recommendations for the BSAI complex				
Quantity	As estimated or specified <i>last</i> year for:		As estimated or recommended this year for:	
	2021	2022	2022	2023
OFL (t)	49,297	47,372	47,790	46,475
maxABC (t)	41,257	39,598	39,958	38,824
ABC (t)	41,257	39,598	39,958	38,824

Tables

Table 1. Estimated catch of skates (t) in the Bering Sea and Aleutian Islands management area. “Official estimate” refers to the catch estimates as of October 17, 2021 maintained by the NMFS Alaska Regional Office in the Catch Accounting System. “Author’s species composition” refers to species-specific catch estimates for Alaska skates and the Other Skates group, calculated by the author based on species composition data from surveys (pre-2007) and fisheries (2007-present).

official estimate		author's species composition	
Year	total BSAI skate catch	Alaska skate catch	Other Skates catch
1992	16,962	15,299	1,663
1993	12,226	11,027	1,199
1994	14,223	12,829	1,394
1995	14,892	13,432	1,460
1996	12,643	11,403	1,240
1997	17,747	15,991	1,756
1998	19,318	17,278	2,040
1999	14,080	12,606	1,474
2000	18,877	16,417	2,460
2001	20,570	17,535	3,035
2002	21,279	19,514	1,765
2003	19,154	17,459	1,695
2004	22,329	20,199	2,130
2005	23,084	21,066	2,018
2006	20,250	18,254	1,996
2007	18,623	15,861	2,762
2008	21,677	15,698	5,979
2009	20,596	16,712	3,884
2010	17,726	13,114	4,613
2011	23,835	18,623	5,213
2012	24,827	19,523	5,304
2013	27,032	22,075	4,957
2014	27,599	21,233	6,367
2015	28,266	21,271	6,996
2016	29,115	23,077	6,038
2017	31,829	24,621	7,209
2018	31,021	23,995	7,026
2019	20,027	15,490	4,536
2020	19,135	14,794	4,341
2021*	17,903	13,841	4,062

* 2021 catch data are incomplete; data retrieved on October 17, 2021.

Table 2. Biomass estimates, 1999-2021, from the NMFS eastern Bering Sea (EBS) shelf bottom trawl survey for the major skate species found on the shelf. CV = coefficient of variation. No bottom trawl surveys were conducted in 2020 due to the coronavirus pandemic

	big		Bering		Aleutian		Alaska	
	biomass	CV	biomass	CV	biomass	CV	biomass	CV
1999	6,492	1.00	9,404	0.20	0		323,240	0.17
2000	5,155	0.83	16,842	0.16	2,232	0.54	311,977	0.06
2001	1,811	0.78	14,263	0.14	1,232	0.61	414,539	0.06
2002	1,489	0.59	12,746	0.16	2,893	0.47	364,004	0.07
2003	0		13,602	0.12	18,253	0.43	372,379	0.05
2004	951	0.71	11,209	0.12	2,494	0.41	424,808	0.05
2005	2,307	0.71	8,774	0.17	8,223	0.56	487,046	0.05
2006	1,036	0.68	11,674	0.13	5,568	0.41	437,737	0.05
2007	1,804	0.76	9,480	0.14	2,718	0.43	479,043	0.07
2008	2,870	0.63	9,943	0.16	6,278	0.57	361,300	0.06
2009	4,500	0.50	13,274	0.18	2,171	0.49	350,233	0.06
2010	3,445	0.66	11,992	0.14	3,332	0.35	366,186	0.06
2011	5,263	0.72	9,795	0.17	2,525	0.54	410,340	0.05
2012	1,161	0.70	10,190	0.16	4,565	0.37	369,881	0.06
2013	3,379	1.00	12,099	0.28	11,483	0.35	386,816	0.06
2014	3,596	0.60	12,570	0.15	8,149	0.41	404,380	0.05
2015	15,438	0.49	12,210	0.13	11,084	0.40	448,224	0.06
2016	10,668	0.54	10,981	0.12	14,449	0.27	550,892	0.04
2017	13,716	0.41	15,249	0.17	36,900	0.56	544,657	0.07
2018	28,731	0.42	14,564	0.11	18,922	0.33	545,994	0.05
2019	11,847	0.37	10,091	0.12	14,899	0.27	491,109	0.05
2021	13,550	0.41	12,226	0.12	17,702	0.26	467,910	0.05

Table 3. Survey biomass estimates (t) of Alaska skate in the northern Bering Sea, 2010-2021. Estimates are from the northern Bering Sea bottom trawl survey that extends north from the historical eastern Bering Sea shelf survey area. CV = coefficient of variation.

	biomass	CV
2010	76,942	0.19
2017	83,255	0.14
2019	95,102	0.15
2021	80,207	0.20

Figures

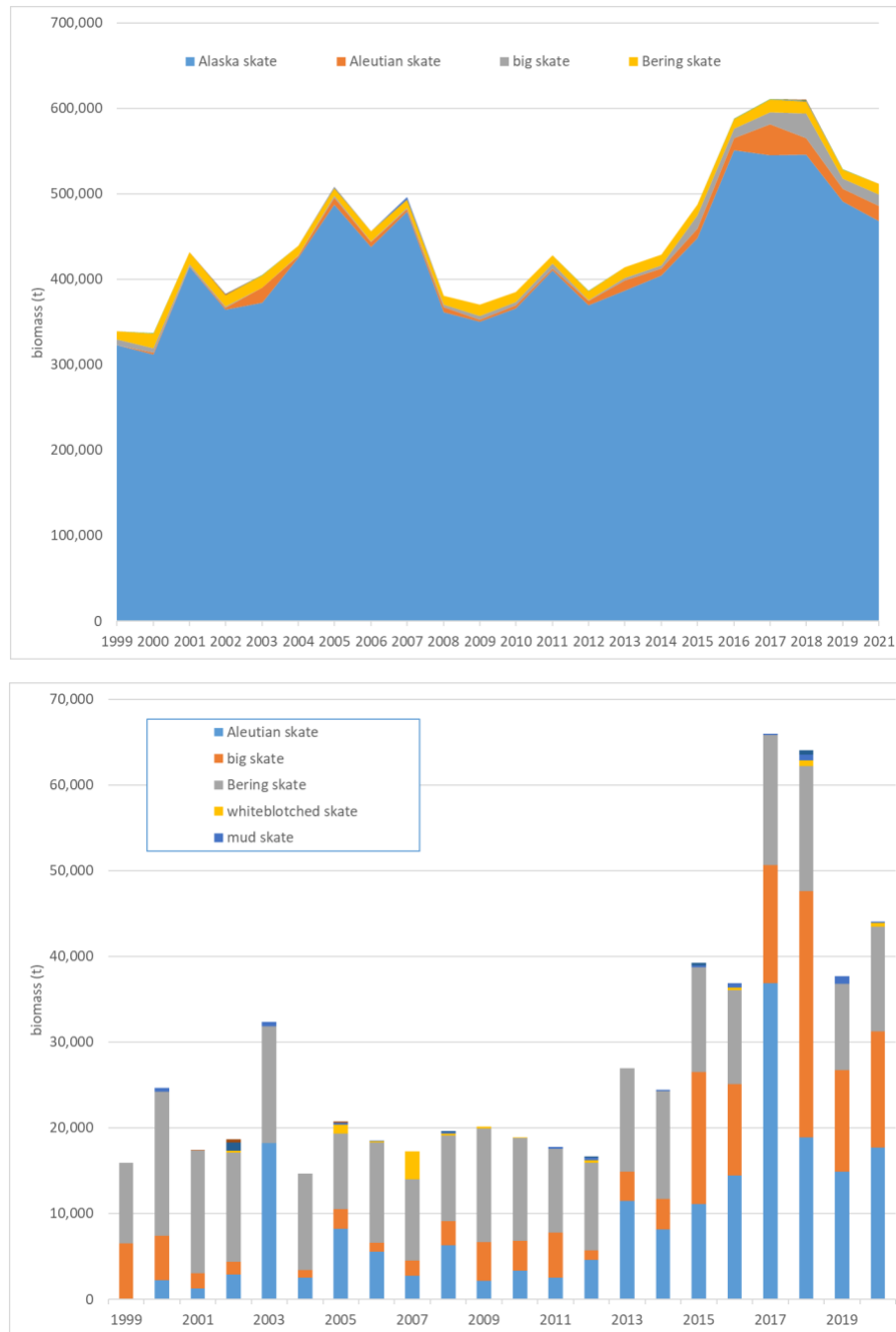


Figure 1. Species composition of survey biomass estimates for skates on the eastern Bering Sea shelf (EBS) by year from 1999-2021. Total biomass (t) is displayed for the assemblage either with (top) or without (bottom) Alaska skate, which is the dominant species. Data are from the NMFS EBS shelf bottom trawl survey; vertical scales differ between plots. No survey was conducted in 2020 due to the coronavirus pandemic.

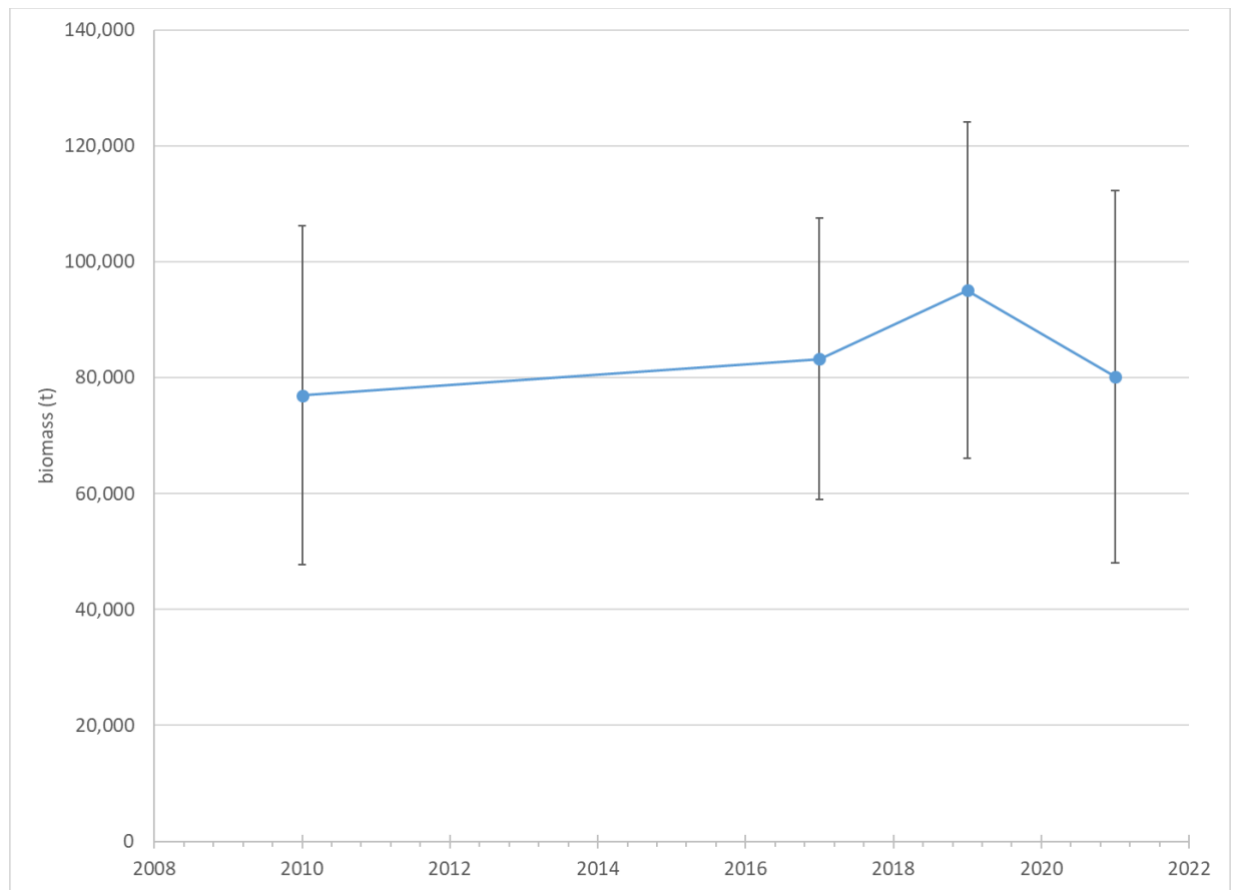


Figure 2. Survey biomass estimates (t) of Alaska skate in the northern Bering Sea, 2010-2021. Estimates are from the northern Bering Sea bottom trawl survey that extends north from the historical eastern Bering Sea shelf survey area.

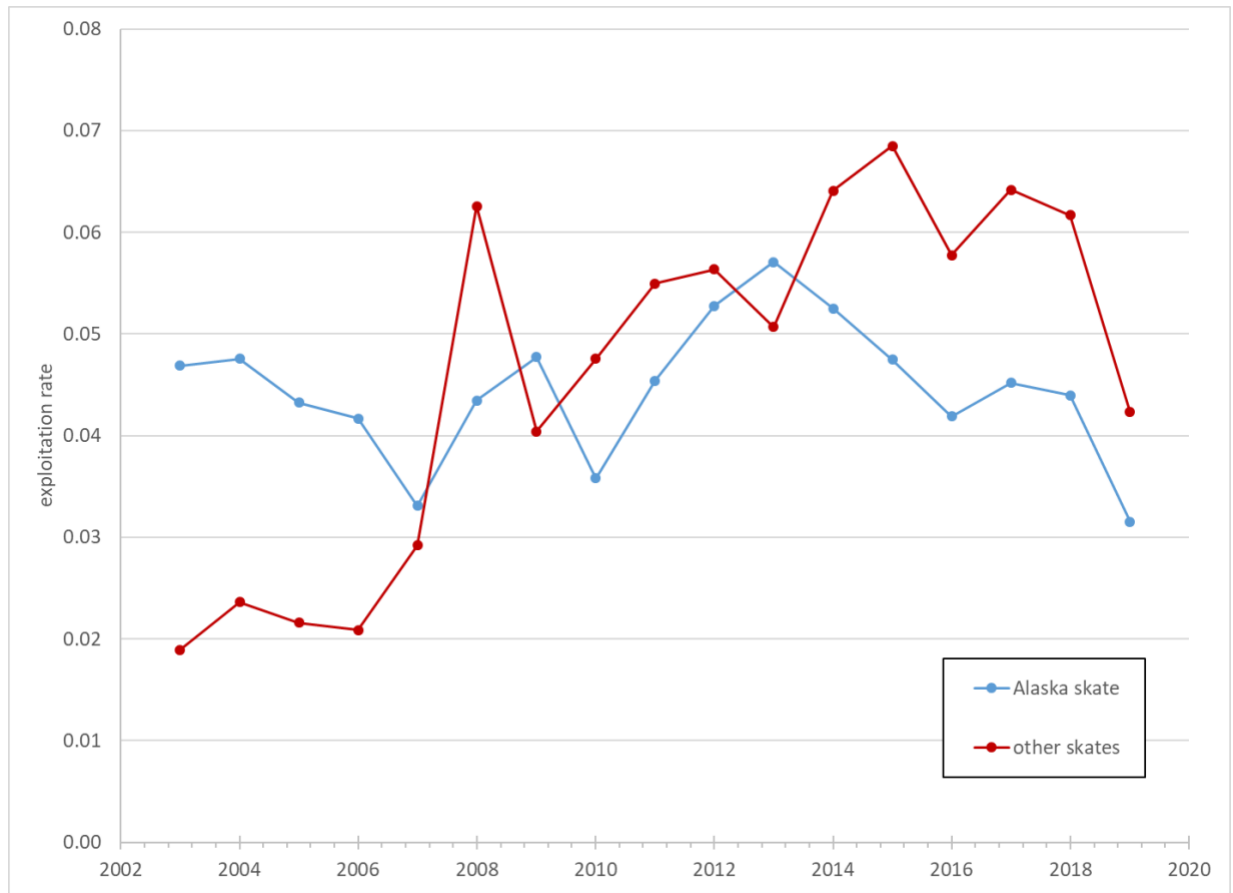


Figure 3. Exploitation rates (total catch/total biomass) for Alaska skate and the Other Skates group in the Bering Sea and Aleutian Islands regions (BSAI), 2003-2019. For both groups, catch data are the author's estimate described in Table 1. For Alaska skate, biomass is the model-predicted total biomass described in Figure 1. For Other Skates, biomass is a combination of three separate random-effects models for each of the three BSAI surveys (eastern Bering Sea (EBS) shelf, EBS slope, and AI). Full description of the random-effects model can be found in the 2020 Bering Sea and Aleutian Islands stock assessment (<https://www.afsc.noaa.gov/REFM/Docs/2020/BSAIs skate.pdf>).